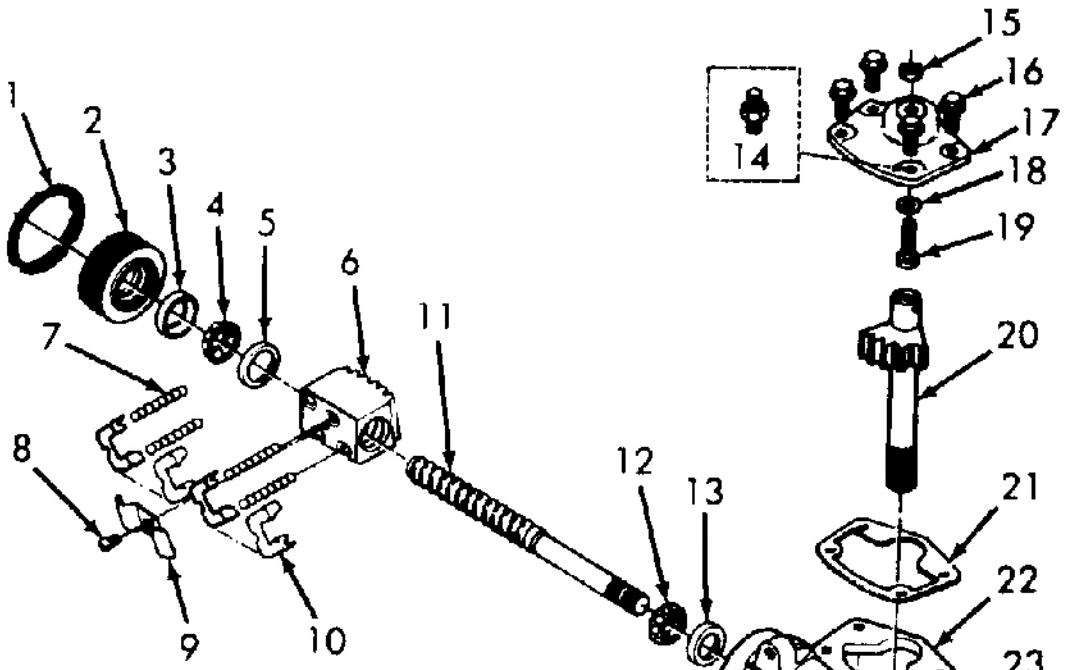
STEERING SYSTEM - MANUAL RECIRCULATING BALL

1996 STEERING General Motors Corp. - Manual Recirculating Ball

DESCRIPTION & OPERATION

Steering gear is a recirculating ball-type consisting of a ball nut connected to steering worm and in-mesh with sector gear. Proper engagement between sector and ball nut is obtained by adjusting screw. Worm bearing adjuster can be turned to provide proper preloading of upper and lower bearings. See **Fig. 1** .

Steering linkage connects steering gear to front wheels through pitman arm. Steering linkage consists of pitman arm, idler arm, relay rod and tie rods. See **Fig. 2** and **Fig. 3** . Tie rod ends connect to relay rod by ball studs. Adjuster tubes between inner and outer tie rod ends are used to adjust toe. 4WD models have a shock absorber attached to relay rod.



1. Worm Bearing Adjuster Lock Nut
2. Worm Bearing Adjuster
3. Lower Worm Bearing Cup
4. Lower Worm Bearing
5. Lower Bearing Retainer
6. Ball Nut
7. Balls
8. Ball Guide Clamp Screw
9. Ball Guide Clamp
10. Ball Guide
11. Worm Shaft
12. Upper Worm Bearing
13. Upper Worm Bearing Cup
14. Top Studded Side Cover Bolt
15. Preload Adjuster Nut
16. Side Cover Bolts
17. Side Cover
18. Preload Adjuster Shim
19. Preload Adjuster
20. Pitman Shaft
21. Side Cover Gasket
22. Housing
23. Worm Shaft Seal
24. Pitman Shaft Needle Bearing
25. Pitman Shaft Seal
26. Spring Washer
27. Pitman Arm Nut

Fig. 1: Exploded View Of Steering Gear
Courtesy of GENERAL MOTORS CORP.

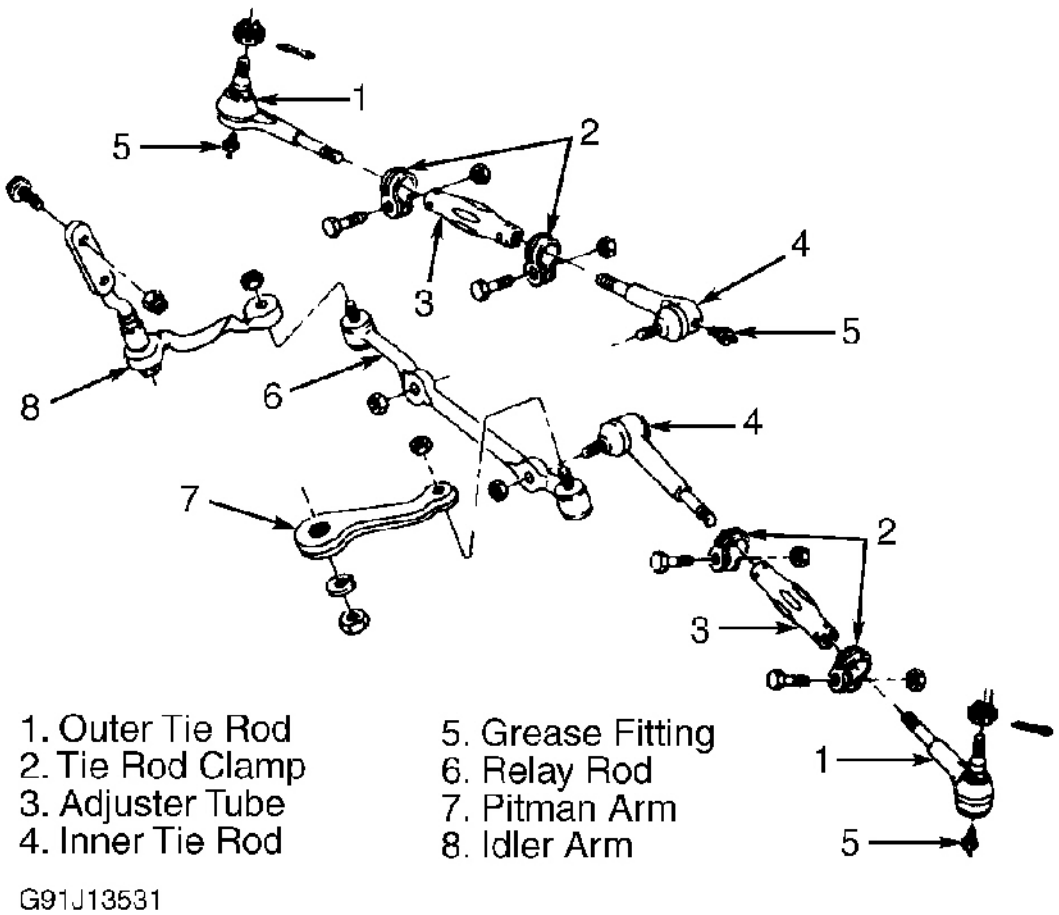


Fig. 2: Exploded View Of Steering Linkage (2WD Models)
Courtesy of GENERAL MOTORS CORP.

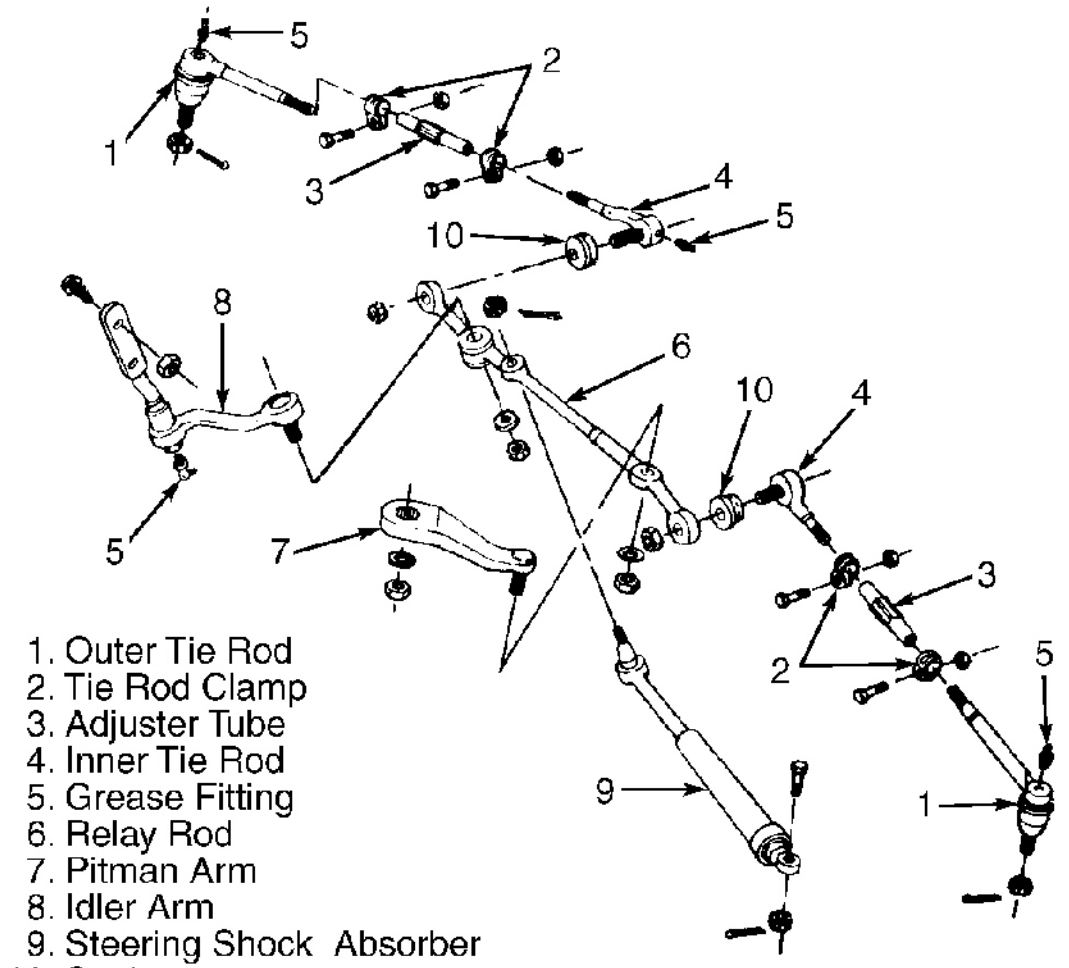


Fig. 3: Exploded View Of Steering Linkage (4WD Models)
Courtesy of GENERAL MOTORS CORP.

LUBRICATION

FLUID TYPE

Manufacturers recommend General Motors Steering Lubricant (1051052). **DO NOT** use EP chassis lube.

FLUID LEVEL CHECK

Steering gear is filled at factory with steering gear lubricant. Lubricant should NOT be changed and steering gear housing should NOT be drained. Additional lubricant should NOT be added to housing.

Steering gear should be inspected for seal leakage of solid grease during service intervals. Housing should be filled with specified lubricant only if a seal is replaced or steering gear is overhauled. **DO NOT** overfill system.

ADJUSTMENTS

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See the COMPUTER RELEARN PROCEDURES article in the GENERAL INFORMATION section before disconnecting battery.

NOTE: Adjust worm bearing preload before performing over-center preload adjustment.

WORM BEARING PRELOAD

1. Inspect shock absorbers, wheel alignment, wheel balance and tire pressure for damage or steering problems before adjusting steering gear. Disconnect battery negative cable. Raise and support vehicle. On 4WD models, remove flexible coupling-to-intermediate shaft retaining screw and remove flexible coupling.
2. On all models, mark relationship of pitman arm-to-pitman shaft. Remove pitman arm nut and spring washer. Remove pitman arm using Puller (J-6632-01) or Remover (J-29107). Loosen worm bearing adjuster lock nut. Back off worm bearing adjuster 1/4 turn. See **Fig. 1** .

CAUTION: DO NOT turn steering wheel hard against stop with steering linkage disconnected or steering gear may be damaged.

3. Remove horn cap. Turn wheel to right stop and back off 1/2 turn. Install INCH-pound torque wrench on steering shaft nut. Rotate steering shaft 90 degrees and note torque wrench reading.
4. Torque required to maintain steering wheel movement should be 5-8 INCH lbs. (.6-.9 N.m). If torque is not within specification, tighten worm bearing adjuster clockwise to increase preload or counterclockwise to decrease preload.
5. Adjust and hold worm bearing adjuster while tightening lock nut. See **TORQUE SPECIFICATIONS** . Recheck worm bearing preload.

OVER-CENTER PRELOAD

1. With worm bearing preload adjusted, turn steering wheel slowly from stop-to-stop while counting total number of turns. Turn steering wheel back to the exact center position.
2. Loosen pitman shaft adjuster screw lock nut (located in center of pitman shaft side cover) clockwise until all lash is taken out between ball nut and sector teeth. See **Fig. 1** . Tighten lock nut. See **TORQUE SPECIFICATIONS** . Rotate steering wheel slightly off center position then attach an INCH-pound torque wrench to steering wheel nut.
3. Rotate steering wheel back through center position and note rotating torque. Rotating torque should be 4-10 INCH lbs. 5-1.1 N.m) in excess of worm bearing preload. Maximum torque should not exceed 16 INCH lbs. (1.8 N.m). If rotating torque is not within specification, adjust pitman shaft adjuster screw.

CAUTION: If maximum torque is exceeded, rotate pitman shaft adjuster screw counterclockwise and adjust by rotating lock nut clockwise.

4. After all adjustments are completed, install pitman arm onto pitman shaft. Ensure pitman arm-to-pitman shaft reference marks are aligned. Install pitman arm spring washer and nut. On 4WD models, install flexible coupling and flexible coupling-to-intermediate shaft retaining screw. Tighten bolts and nuts to specifications. See the **TORQUE SPECIFICATIONS** table.

REMOVAL & INSTALLATION

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See the COMPUTER RELEARN PROCEDURES article in the GENERAL INFORMATION section before disconnecting battery.

STEERING GEAR

Removal

1. Position front wheels in straight-ahead position and note position of steering wheel. Disconnect battery negative cable. On 4WD models, remove flexible coupling-to-intermediate shaft retaining screw and remove flexible coupling. On 2WD models, remove shield from intermediate shaft. On all models, remove lower clamp bolt and lower clamp from worm shaft.
2. Mark relationship of pitman arm-to-pitman shaft. Remove pitman arm nut and spring washer. Remove pitman arm using Puller J-6632-01) or Remover (J-29107). Remove steering gear mounting bolts and washers. Remove steering gear.

Installation

To install, reverse removal procedure. Check position of steering wheel. Ensure lower clamp bolt hole is aligned with groove in worm shaft. Ensure pitman arm-to-pitman shaft reference marks are aligned. Tighten retaining bolts and nuts to specification. Refer to the **TORQUE SPECIFICATIONS** table.

INNER & OUTER TIE ROD ENDS

Removal

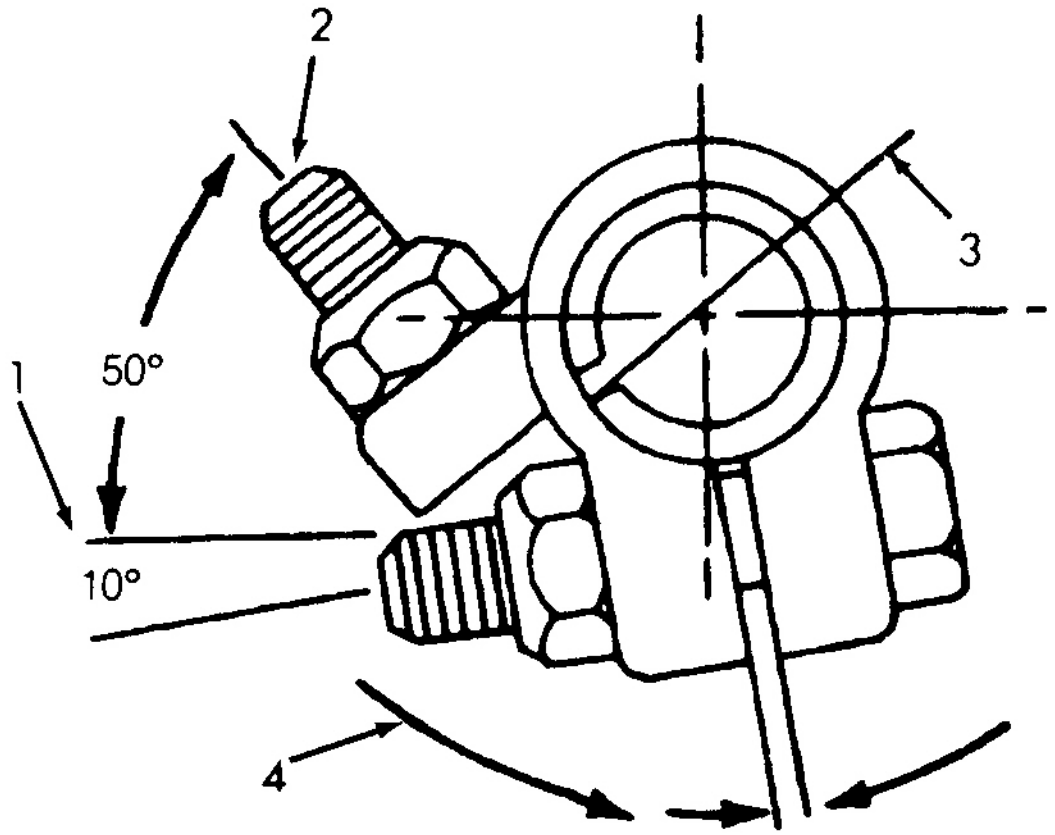
Raise and support vehicle. Remove cotter pins and outer tie rod end nuts. Remove inner tie rod end nuts. Using Wheel Stud and Tie Rod Remover (J-6627-A), remove outer tie rod ball studs from steering knuckle and inner tie rod ball studs from relay rod. Loosen adjuster tube clamp bolts and clamps. Unscrew and remove tie rod ends from adjuster tube.

Installation

1. Lubricate tie rod end threads with chassis lubricant before installing. Install inner and outer tie rod ends to adjuster tube. Inner and outer tie rod end threads must be adjusted equally within 3 threads. Install adjuster clamps and clamp bolts. Ensure clamps are positioned between locating dimples on ends of adjuster tube.
2. Tie rod ends must rotate full travel and travel must be maintained during clamp tightening. Slot in adjuster tube and slot in clamp must be properly positioned. See **Fig. 4** .
3. Install inner tie rod ends to relay rod ensuring seal is on ball stud. Tighten Steering Linkage Installer (J-29193) or J-29194) to 40 ft. lbs. (54 N.m) to seat tapers. Install and tighten inner tie rod end-to-relay rod nuts. Install outer tie rod end to steering knuckle.

CAUTION: When installing outer tie rod end nut, tighten nut to align cotter pin hole. DO NOT tighten nut more than an additional 1/6 turn to align cotter pin hole. DO NOT back off nut to insert cotter pin.

4. Install and tighten outer tie rod end nut. Tighten bolts and nuts to specifications. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See the WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.



1. Horizontal Line
2. Center Line Of Bolt
3. Adjuster Tube Slot
4. Rearward Rotation

Fig. 4: Positioning Tie Rod End & Adjuster Tube Clamp
Courtesy of GENERAL MOTORS CORP.

RELAY ROD

Removal

Raise and support vehicle. Remove inner tie rod end nuts. Remove inner tie rod ends from relay rod. On 4WD Models, remove steering shock absorber nut from relay rod. Using Steering Linkage Puller (J-24319-01), remove steering shock absorber from relay rod. On all models, remove relay rod end nuts from pitman arm and idler arm. Using Steering Linkage Puller (J-24319-01), remove pitman arm and idler arm from relay rod. Remove relay rod. See **Fig. 2** and **Fig. 3** .

Installation

To install, reverse removal procedure. Ensure seals are on ball studs. Using Steering Linkage Installer (J-29193 or J-29194), seat all tapers to 40 ft. lbs. (54 N.m). Tighten nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. Refer to the WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.

IDLER ARM

NOTE: Replace idler arm assembly if an up and down force of 25 ft. lbs. (110 N.m), applied at relay rod end of idler arm, produces a lash of more than 1/8" (3 mm) for a total of 1/4" (6 mm) in straight-ahead position. See Fig. 5 .

Removal

Raise and support vehicle. Remove idler arm-to-frame nut and bolt. Remove idler arm nut and spring washer from relay rod. Using Steering Linkage Puller (J-24319-01), remove idler arm from relay rod. Remove idler arm. See **Fig. 2** and **Fig. 3** .

Installation

To install, reverse removal procedure. Ensure seal is on ball stud. Using Steering Linkage Installer (J-29193 or J-29194), seat tapers to 40 ft. lbs. (54 N.m). Tighten nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See procedures in the WHEEL ALIGNMENT SPECIFICATIONS & PROCEDURES article in the WHEEL ALIGNMENT section.

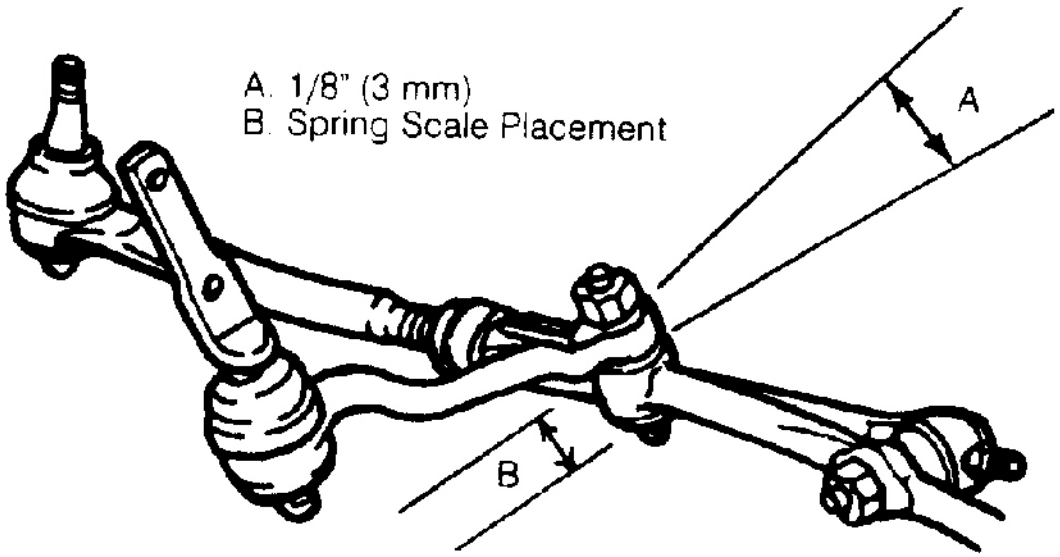


Fig. 5: Checking Idler Arm Play
Courtesy of GENERAL MOTORS CORP.

PITMAN ARM

Removal

1. Raise and support vehicle. Disconnect air induction assembly. Slide up intermediate shaft cover. Mark intermediate shaft for reassembly. Remove intermediate shaft. Disconnect oil filter lines at crossmember bracket. Remove splash shield.
2. Remove pitman arm nut and spring washer from relay rod. Using Steering Linkage Puller (J-24319-01), remove pitman arm from relay rod.
3. Remove lower steering gear bolts. LOOSEN upper steering gear bolt. Rotate steering gear for pitman arm clearance at crossmember and support with block of wood.
4. Mark relationship of pitman arm-to-pitman shaft position. Remove pitman arm nut and spring washer from pitman shaft. Using Remover (J-6632-01) or Puller (J-29107), remove pitman arm from pitman shaft. See **Fig. 2** and **Fig. 3** .

Installation

To install, reverse removal procedure. Ensure pitman arm-to-pitman shaft reference marks are aligned. Ensure seal is on ball stud. Using Steering Linkage Installer (J-29193 or J-29194), seat tapers to 40 ft. lbs. (54 N.m). Tighten retaining nuts to specification. See the **TORQUE SPECIFICATIONS** table.

PITMAN SHAFT SEAL

NOTE: Pitman shaft seal may be replaced without removing steering gear from vehicle.

Removal

1. Position front wheels in straight-ahead position and note position of steering wheel. Disconnect battery negative cable. Mark relationship of pitman arm-to-pitman shaft. Remove pitman arm nut and spring washer. Remove pitman arm using Puller (J-6632-01) or Remover (J-29107).
2. Remove pitman shaft side cover bolts. Remove pitman shaft and side cover assembly from housing. Pry pitman shaft seal from housing using a screwdriver. **DO NOT** damage housing bore. Remove pitman shaft adjuster screw lock nut. Remove pitman shaft side cover from sector assembly by turning adjuster screw clockwise.
3. Inspect gear lubricant for contamination. If lubricant is contaminated in any way, gear must be removed and overhauled.

Installation

1. Lubricate NEW pitman shaft seal with steering gear lubricant. Position seal in pitman shaft bore and tap it into place using a 1" (25 mm) pipe or socket.
2. Install pitman shaft into steering gear ensuring center tooth of sector enters center tooth space of ball nut. Fill gear housing with lubricant, and install NEW side cover gasket on gear housing. Install side cover over pitman shaft. Reach through side cover hole using screwdriver.
3. Turn pitman shaft adjuster screw counterclockwise until screw bottoms and then back off screw 1/4 turn. Install pitman shaft side cover bolts and pitman shaft adjuster screw lock nut. Adjust worm bearing preload and over-center preload. See **WORM BEARING PRELOAD** and **OVER-CENTER PRELOAD** under ADJUSTMENTS.
4. Install pitman arm on pitman shaft. Ensure pitman arm-to-pitman shaft reference marks are aligned. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS** .

STEERING SHOCK ABSORBER

Removal (4WD)

Remove steering shock absorber nut from relay rod. Using Steering Linkage Puller (J-24319-01), remove steering shock absorber from relay rod. Remove steering shock absorber-to-frame cotter pin, nut and bolt. Remove steering shock absorber. See **Fig. 3** .

Installation

To install, reverse removal procedure. Ensure seal is on ball stud. Using Steering Linkage Installer (J-29193 or J-29194), seat tapers to 40 ft. lbs. (54 N.m). Tighten nuts to specification. See **TORQUE SPECIFICATIONS** .

OVERHAUL

DISASSEMBLY

1. Place steering gear in vise, clamping onto one mounting tab. Worm shaft should be in a horizontal position. Rotate worm shaft from stop to stop while counting total number of turns. Turn worm shaft back to exact center position.
2. Loosen pitman shaft adjuster screw lock nut. Remove pitman shaft side cover bolts. Remove pitman shaft and side cover assembly from housing.
3. Loosen worm bearing adjuster lock nut. Remove worm bearing adjuster with lower bearing cup, bearing and bearing retainer. See **Fig. 1** . Remove ball nut and worm shaft assembly.

CAUTION: DO NOT allow ball nut to rotate down to either end of worm shaft, as ball guide ends may be damaged.

4. Remove remaining upper bearing and bearing cup from housing. Using screwdriver, pry lower bearing retainer from worm bearing adjuster assembly and remove lower bearing. Remove pitman shaft adjuster screw lock nut.
5. Hold pitman shaft side cover from sector assembly by turning adjuster screw clockwise. Remove pitman shaft adjuster screw and shim from pitman shaft. Pry out and discard both pitman shaft and worm shaft seals. Remove pitman shaft needle bearing and worm shaft upper bearing only if replacement is necessary.

CLEANING & INSPECTION

Clean components with solvent and dry with compressed air. Inspect bearings and cups for signs of wear. Inspect pitman shaft fit at side cover. Check ball nut and worm shaft assembly for wear and straightness. Inspect housing for burrs.

COMPONENT SERVICE

Pitman Shaft Bearing Replacement

Support steering gear in an arbor press. Using Bearing Remover (J-6278), drive pitman shaft needle bearing from housing. Install NEW needle bearing into housing using Bearing Installer J-35469 and J-8092).

Worm Shaft Lower Bearing R & I (In Worm Bearing Adjuster)

Using slide hammer and Puller (J-29369-1), remove lower bearing retainer, bearing and bearing cup from worm bearing adjuster. Using Bearing Installer (J-35365), install bearing cup, lower bearing and bearing retainer in worm bearing adjuster.

Worm Shaft Upper Bearing Replacement (In Housing)

Using a hammer and punch, remove upper bearing and bearing cup from housing. Using Bearing Installer (J-35365), install NEW upper bearing and bearing cup in housing.

Ball Nut & Worm Shaft Assembly

Ball nut disassembly is only necessary if binding or tightness exists while rotating worm shaft. If disassembly is required, proceed to step 1).

CAUTION: Note number of balls located in each circuit of ball nut. Correct amount must be installed in each circuit. Note direction of ball nut installation on worm shaft.

1. Remove ball guides retaining clamp. Pull guides from ball nut while catching balls in clean pan. **DO NOT** lose balls. Turn nut over and rotate worm shaft until all balls have been removed.

2. Remove worm shaft from ball nut. Wash parts, and inspect worm, nut grooves and ball bearings for indentations. Check ball guides for damage at ends where they deflect or pick up balls from helical path on worm shaft.
3. Measure distance between ball grooves of worm gear. Distance between grooves determines amount of balls to be installed in each circuit. See **BALL USAGE** table.

BALL USAGE

Groove Distance: In. (mm)	Balls Per Circuit
.04 (1.0)	25
.10 (2.5)	27
.20 (5.0)	27

4. To reassemble ball nut and worm shaft, install ball nut with narrow end of ball nut teeth upward on right side (looking from steering wheel end of worm shaft). Install worm shaft. Ensure worm shaft is aligned with grooves in ball nut.
5. Install guides in ball nut. Install proper amount of balls in one guide hole while rotating worm shaft. Repeat procedure for remaining guide. Install guide clamps and bolts.

REASSEMBLY

1. Place steering gear housing in a vise with worm shaft bore horizontal and side cover opening facing upward. All seals, bushings and worm shaft bearing cups should be installed.
2. Place upper ball bearing over worm shaft. Install worm shaft and ball nut assembly into housing and up through the upper bearing cup and seal. Install lower bearing, bearing cup and bearing retainer in worm bearing adjuster.
3. Install worm shaft and worm bearing adjuster in housing. Tighten worm bearing adjuster until a slight amount of worm shaft end play exists. Install pitman shaft adjuster screw and shim in slotted end of pitman shaft.
4. Using feeler gauge, check clearance between adjuster screw and pitman shaft when holding adjuster screw upward. Clearance should not exceed .002" (.05 mm). If clearance exceeds specification, a different thickness shim should be installed.
5. Rotate worm shaft until ball nut is at center of its travel. Install pitman shaft into steering gear ensuring center tooth of sector enters center tooth of ball nut.
6. Fill gear housing with lubricant, and install NEW side cover gasket on gear housing. Install side cover over pitman shaft. Reach through side cover hole using screwdriver.
7. Turn pitman shaft adjuster screw counterclockwise until screw bottoms and then back off screw 1/4 turn. Install pitman shaft side cover bolts and pitman shaft adjuster screw lock nut. Adjust worm bearing preload and over-center preload. See **WORM BEARING PRELOAD** and **OVER-CENTER PRELOAD** under ADJUSTMENTS.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Idler Arm-To-Frame Nut	60 (81)
Inner Tie Rod-To-Relay Rod Nut	35 (47)
Outer Tie Rod-To-Steering Knuckle Nut	35 (47)
Pitman Arm-To-Pitman Shaft Nut	185 (250)
Pitman Shaft Adjuster Screw Lock Nut	22 (30)
Pitman Shaft Side Cover Bolts	13 (18)
Relay Rod-To-Idler Arm Nut	
2WD	35 (47)
4WD	60 (81)
Relay Rod-To-Pitman Arm Nut	
2WD	35 (47)
4WD	60 (81)
Skid Plate Bolts	24 (32)
Steering Gear Lower Clamp Bolt	30 (41)
Steering Gear Mounting Bolts	55 (75)
Steering Shock Absorber	
To-Frame Nut	26 (35)
To-Relay Rod Nut	45 (62)
Tie Rod Adjuster Tube Clamp Bolt	14 (19)
Worm Bearing Adjuster Lock Nut	85 (115)
	INCH Lbs. (N.m)
Adjuster Plug Preload	5-9 (.6-1)
Clamp-To-Ball Nut Screw	49 (5.5)
Flexible Coupling Retaining Screw	51 (5.8)
Over Center Preload	4-11 (.5-1.2)
Total Steering Gear Preload	16 (1.8)

1996 Chevrolet Blazer

STEERING SYSTEM - MANUAL RECIRCULATING BALL 1996 STEERING General Motors Corp. - Manual Recirculating Ball